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BRITISH MANUFACTURING INDUSTRIES

British Manufacturing Industries. By Various Authors. Edited by G. Phillips Bevan. (London: Edward Stanford.)

IN this series we have presented to us an account of the origin and development of those industries which have given this country her pre-eminence among nations. As stated by the editor, the object of the various treatises is simple and unambitious; no attempt is made to render them technical guides to the industries to which they relate; the main idea is to give, in as readable a form as is compatible with accuracy and a freedom from superficiality, the main features and present position of the leading industries of the kingdom, so as to enable general readers to comprehend the enormous growth of the last quarter of a century. The editor has been singularly fortunate in the selection of his co-operators. For example, Prof. Warington Smyth tells us all about the mines and collieries of the country; Prof. Hull discourses on quarries and building stones; Capt. Bedford Pim on shipbuilding; Mr. Mattieu Williams finds congenial themes in iron and steel, gunpowder and explosives. The article on cotton by Mr. Isaac Watts, the Secretary of the Cotton Supply Association, is remarkably full and complete; Mr. Felkin's little treatise on hosiery and lace is a perfect mine of information, and forms a most interesting record of perseverance and effective skill; the stories of Jedediah Strutt and John Heathcoat will ever be two of the most thrilling chapters in the history of the industrial progress of this country. Indeed this series might have been fitly called the Romance of British Industry. We are told of Lee and the stocking-frame; of Wedgwood and Herbert Minton; of Hargreaves, Arkwright, and Crompton; of Dud Dudley and poor Cort; and of numbers of others, whose peaceful victories have done more for this country than all the machinations of her statesmen or the valour of her armies. *Apropos* of the invention of the stocking-frame it may be remarked that Elmore's well-known picture, representing Lee, after his expulsion from his college, intently watching the lissom fingers of his wife as she knits for the support of the household, in order that he might imitate their motion, is founded on a myth. Lee was a decent country curate in easy circumstances; he was never married, nor was he expelled from his college. But little is known of his history, beyond that, becoming greatly discouraged with the reception of his invention in this country, he passed over to France, where he died, neglected and in misery, in 1610. The history of the improvement of the stocking-frame is not less interesting than that of its origin. Since the time of Strutt, nearly 300 changes and adaptations have been patented, the vast majority of which are due to men who commenced life at the forge or bench, or at the frame itself.

The history of the rise and development of the lace manufacture is scarcely less remarkable, and Mr. Felkin has much to say concerning the personal history of its founders and of the trials and struggles of the inventors and improvers of lace-making machinery. Few trades have probably given rise to such an amount of litigation: indeed one can have no real conception of the immensity of the barrister's theme, or how eloquent he must have seemed to the beaver when—

> "he proceeded to cite
> A number of cases where the making of laces
> Had proved an infringement of right."

until he has read this essay. The story is painfully sad, and its moral is not lost on Mr. Felkin. "We cannot but remark," he says, "the extraordinary amount of latent inventive skill brought into operation by men entirely uninstructed in the science of mechanics; and be struck with the time and thought that the knowledge of sound mechanical principles would have saved them. . . . It is painful to notice how many of these men, possessing fine natural talents, from the want of self-government failed to use aright even the measure of profit that reached them. . . . Genius was to them rather a curse than a blessing. Here are strong arguments for higher scientific and moral education to be placed within reach of these classes."

Mr. Mattieu Williams concludes his capital little treatise on steel with a similar reflection. He indignantly protests against the fallacy of attributing our industrial success to coal or iron-stone, or to any other mere mineralogical or geographical accident. "It is not British minerals, but British industrial energy which has given us our industrial supremacy. It is not true that we are so exceptionally rich in coal. Many other nations possess vastly greater stores than ours; but while theirs has lain buried under their feet, ours has been brought to the surface and wonderfully used; to such an extent indeed, that we are actually approaching the limits of our supply before other and older people have tapped theirs. . . The same energies which have thus seized upon and utilised the rudest source of power to supply the coarser wants of ourselves and the rest of mankind, will if properly directed, similarly turn to account the more refined and recondite energies of nature which science is revealing, and which will supply in like manner the higher wants of more advanced civilisation. To succeed in this we must prepare at once, by affording to all classes the largest attainable amount of knowledge of the raw materials and powers of nature; of human means of turning these to profitable account; of the social organisation in the midst of which we live, and by which we are to co-operate industrially with each other and all the peoples of the earth; and above all, of the individual moral qualities, habits, and attainments that are necessary for each man's industrial success."

It is because other nations are actually turning to account "the more refined and recondite energies of nature" that our industrial supremacy is threatened. In chemical manufacturing, for example, the pre-eminence of the alkali trade belongs to us, but, as Prof. Church tells us, German, Austrian, and French manufacturers are far ahead of us in the production of the finer and more delicate preparations of the chemist, and still continue to make remarkable progress. "If a rare and curious substance, discovered by a scientific chemist and made in his laboratory painfully grain by grain, be found useful in medicine or dyeing, or some other art, straightway the foreign manufacturing chemist makes it, not by the ounce or pound merely, but by the hundredweight or

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even by the ton." Much of the crude material which yields these beautiful and costly products of the continental manufactories is exported from England to be worked up and reimported. The reason of this lies in the more intimate union of science and manufactures which prevails abroad. The chemical manufacturer on the continent finds it to his interest to attach a sound and properly-trained chemist to his works to improve the established methods of production and to seek to discover new processes.

With the space at our disposal it is impossible to do more than merely indicate the scope and character of this series of excellent treatises. There are one or two little matters which need revision, and which the editor will doubtless set right in future editions: for example, the combining proportion of tin is not usually stated as 58, nor that of zinc as 32·6. Perhaps the most serious drawback is the very sparing use of illustrations. When given they are generally very good; nothing could exceed the beauty and finish of the cuts accompanying Mr. Watts' article on cotton. We are sorry that the example thus set has not been more generally followed. T.

HUTTON'S "GEOLOGY OF OTAGO"

Report on the Geology and Gold-fields of Otago. By F. W. Hutton, F.G.S., Provincial Geologist, and G. H. F. Ulrich, F.G.S., &c. (Dunedin: Mills, Dick, and Co.; London: Sampson Low and Co., 1876.)

THE Southern Province of New Zealand is one of great interest from the variety of its physical features which faithfully indicate the wide range of geological formations of which it is built up. The snow-clad ridge of "The Southern Alps," with numerous pointed peaks and serrated ridges, runs along the western coast, and is penetrated by deep "sounds," or fiords, not unlike some of those on the west coast of Norway. Mount Aspiring, at the northern border of the province, reaches an elevation of 9,940 feet, while several other points rise upwards of 8,000 feet above the sea, forming altogether a grand background, from which the rest of the country descends towards the eastern coast in a series of rolling downs, diversified by deep valleys and numerous lakes. The rivers are remarkable for, in several cases, and with much perversity, cutting through ridges, and crossing the boundaries of the formations, in a way that not long ago would have been attributed to the effects of mighty "convulsions of Nature," but which the physical geologist is now able to account for on very different principles. The Southern Alps contain glaciers which, as Mr. Hutton shows very clearly, extended considerably beyond their present bounds on two occasions in later Tertiary times, and to this agency he refers the excavation of the rock basins which now constitute nearly all the lakes of the hilly districts. An excellent view of this chain of snowy mountains will be found in Dr. von Hochstetter's elaborate work on New Zealand; in which Mount Cook, Mount Tasman, and the adjacent mountain giants are seen towering to an elevation of 13,200 feet above the waters of the ocean.

The work before us is a very carefully prepared, and scrupulously accurate, report on the physical features and geological structure of the district of Otago which, under the direction of Dr. Hector, the author has explored and mapped. The arrangement of the matter is good, and the descriptions succinct, while the writer is careful to notice the labours of others in the same field of research. The roughness of some of the woodcut illustrations, which one cannot fail to notice, is perhaps inseparable from a work brought out in a young colony, and is not to be laid to the charge of the author.

As already observed, the geological formations of Otago have a wide range in time, extending from the crystalline masses of the New Zealand Alps (possibly referable to the Laurentian period) through the representatives of the Lower Silurian, Carboniferous, Triassic, Jurassic, Cretaceous, and Tertiary times down to the present day. The thickness of some of these older formations is doubtless very great, but the difficulty which the author feels in estimating the apparent thickness of some of these formations at the amount deduced from the dip of the beds may probably be overcome by supposing that the beds are folded over on themselves—a phenomenon of very common occurrence in such districts as that of the New Zealand Alps. The Otago formations have very properly received names derived from localities where they are well represented. The reference to the equivalent formations in Europe is given with some hesitation; nevertheless, it cannot be doubted that on the whole these determinations are substantially correct—even if we suppose a relative, rather than an absolute, synchronism owing to the vast intervening space between Europe and New Zealand; and for all purposes of comparison it is not of the slightest importance whether it is one or the other.

The great oscillations of level through which New Zealand has passed are well described and illustrated by Mr. Hutton under the head of "Historical Geology." These correspond to some extent with the movements which in Britain and Europe have enabled us to define the limits of the three great divisions of geological time. Towards the close of the Palæozoic period "New Zealand probably formed a subordinate part of a large continent, which, judging by the similarity of the shells and plants, joined in the following formations with those of Australia, India, and Europe, probably stretched far away to the northward" (p. 75).

At the commencement of the Triassic period this continent began in New Zealand to be submerged; and with one or more slight oscillations this subsidence continued till towards the middle of the Jurassic period, when the whole country was again elevated, and the chain of the New Zealand Alps was formed. Great denudation of the upraised beds ensued, as they remained exposed to the atmosphere till the later Cretaceous period. Hence the unconformity between the Upper Cretaceous and the Lower Jurassic rocks (the Warpara and Putataka formations), and the entire absence of the intervening strata. Since the great upheaval here referred to, the New Zealand Alps have never been totally submerged, though sometimes deeply depressed.

The Upper Cretaceous period was one of submergence to all but the higher elevations, and at its close there was another elevation, accompanied by disturbances of the strata, resulting in an unconformity between the Tertiary beds and all those of older date. These former are found

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